



# **Next Generation Air Transportation System (NGATS) Air Traffic Management (ATM) - Airportal Project**

## **Reference Material**

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# **1. Technical Plan**

*Chapter 1 Technical Plan contains the NGATS ATM-Airportal Project goal and performance objectives and a discussion of the relevance of the project research to the national need and JPDO vision for the NGATS. A list of project milestones, metrics, and deliverables is being developed and will be available soon. A description of the technical approach to carrying out and validating the NGATS ATM-Airportal Project research agenda, including collaborative activities with the NGATS ATM-Airspace Project, is also being developed and will be available soon.*

## **1.1 NGATS ATM-Airportal Project Goal and Performance Objectives**

### **1.1.1 Project Goal**

The NGATS ATM-Airportal Project goal is to dramatically increase throughput in the terminal and airport airspace (airside and on the surface) to meet future air transportation demand. This work is to enable transformation leading to the NGATS, as defined by the JPDO. The NGATS is a multi-agency vision and plan to meet serious challenges facing the U.S. air transportation system, and projected to operate by the year 2025.

### **1.1.2 Performance Objectives**

Working in close collaboration with the NGATS ATM-Airspace Project, the NGATS ATM-Airportal Project will develop and validate algorithms, technologies, and procedures for use in enabling integrated solutions that will safely expand capacity and increase efficiency in the airport domain of the air transportation system—i.e., improving the efficiency of operations on the runway complex and in the use of gates, taxiways, runways, and final approach airspace. Performance objectives include the use of 4D trajectories (aircraft path from “block-to-block,” including the path along the ground) to plan and execute system-wide operations. Block-to-block trajectory management will incorporate the portion of the trajectory that is accomplished on the ground—from “the blocks to rotation” and from “touchdown to the blocks.”<sup>1</sup>

## **1.2 Research Relevance**

### **1.2.1 Problem Statement**

Airportal surface operations represent a significant constraint in the National Airspace System (NAS) today. One factor is the impact of dramatically increased demand at hub airports on operational volume, which is approaching maximum capacity. Another is the complexity of the airport environment: the geographic constraints of runways, taxiways, and gates; the sheer numbers of aircraft needed to accommodate demand; the variety of aircraft types and ground vehicles and range of performance levels. Additional factors include weather and wake considerations and multiple users attempting to adapt to unplanned events and changes in the system with limited or no knowledge of other users or plans. The result is an inflexible airport environment that is unable to respond quickly to unplanned events or sudden change and poses a potential bottleneck that could disrupt the entire NAS.

Airportal operations will continue to grow in a variety of dimensions. According to the JPDO, the number of passengers needing access to the air transportation system could increase

from 2 million a day today to 4 or 5 million by 2025.<sup>2</sup> Increasing capacity throughout the air transportation system to meet this demand is not possible without reducing or eliminating serious capacity-limiting factors on the ground as well as in the air. It is in this environment of the airportal that the NGATS ATM-Airportal Project will conduct research.

The JPDO has defined a national vision for air transportation in 2025. A key goal is to “build new capacity while making better use of our airports and airspace” in order to “satisfy future growth in demand (up to three times current levels) and operational diversity.”<sup>3</sup> The NGATS Operational Concept as defined by the JPDO identifies airport operations as an important area where improvements must be made, calling for a reduction in single runway occupancy times; improved wake vortex sensing and prediction technologies; and increased use of automated approach, landing, and departure systems to take full advantage of existing and new runways. The 2025 NGATS will also require a reduction in current separation standards, along with use of 4D<sup>4</sup> trajectory technologies and procedures to better predict and ensure that safe wake avoidance can be achieved. In addition, regional airports must coordinate planning among multiple facilities while balancing transportation needs with environmental concerns.

### **1.2.2 Current State of the Art**

In today’s airport surface operations, humans make decisions with highly complex outcomes using historically defined static procedures and, in some cases, limited software-based decision-support capabilities. The constraints within the airportal environment create inflexibility that prevents users from achieving capacity gains made elsewhere in the system. In addition, poorly distributed information, minimal use of advanced decision-support capabilities, little or no automation, human performance constraints, and the absence of integration across the air transportation system limits NAS efficiency, predictability, capacity, and user preferences. Thus, the airportal surface environment creates the ultimate constraint in the NAS: if aircraft are unable to move into and out of the airportal environment, system-wide capacity expansion will be impossible.

### **1.2.3 ARMD Investment Justification (Why NASA?)**

As the nation’s leading government organization for aeronautical research, NASA has historically provided the foundations for many innovations that have led to new products and jobs in the public sector. As a world-class leader in surface and terminal area traffic management R&D, NASA’s Aeronautics Research Mission Directorate (ARMD) and the Airspace Systems Program (ASP) can provide the foundation for many of the innovations that will enable the NGATS. To achieve these innovations, sophisticated new automation and decision-support tools must be developed to support a wide range of users and functions. NASA’s ASP is uniquely qualified to initiate this effort with long-term investment in cutting-edge fundamental research to enable the transformation of the air transportation system. With a primary emphasis on the operational management of the NAS, ASP has the expertise and facilities to develop the concepts, capabilities, and technologies for high-capacity, efficient, and safe airspace and airport systems.

Demonstrating NASA’s charter to address national needs and benefit the public, ARMD has managed a number of programs with projects that focused upon automation solutions for the NAS—e.g., the Terminal Area Productivity (TAP) Project, the Advanced Air Transportation Technologies (AATT) Project, and the Virtual Airspace Modeling and Simulation (VAMS) Project. These projects led to a number of successful concepts, technologies, and decision-

support tools for surface operations, including the Aircraft Vortex Spacing System (AVOSS) Prediction Algorithm for wake prediction, the Surface Management System (SMS), and the Advanced Concept Evaluation Simulation (ACES) model. R&D activities were conducted with a fundamental understanding of system requirements and evaluation techniques, and through close collaboration with user communities. In addition, NASA maintains unique laboratory resources for assessing NAS concepts and technologies, including facilities for conducting fast-time simulation, human-in-the-loop simulation, and operational field evaluations. Development of the 2025 NGATS Operational Concept will require considerable investment in foundational research to support the development and testing of decision-support tools capable of safely enabling the expansion of NAS capacity to meet future demand. NASA's ARMD is uniquely qualified to conduct this foundational research.

#### **1.2.4 Rationale for Research Not Pursued**

Resource constraints and competing priorities limit the degree to which the NGATS ATM-Airportal Project can pursue airport R&D to support the 2025 NGATS Operational Concept, vision, and goals. In particular, the project will not pursue research in airport communications, navigation, surveillance and information sharing (CNSI). However, the project will address many technical requirements associated with Super-Density Operations, Equivalent Visual Operations, and Aircraft Trajectory-Based Operations as identified in "JPDO Agency Guidance for FY08." In research areas where additional support and resources are required, NASA will rely on partnerships with other government agencies (OGAs), industry, and academia. The NGATS ATM-Airportal Project will leverage the partnerships to complement its efforts in fundamental technology development by extending the work to a system-wide level, including operational considerations.

OGAs that have conducted work in airport-related areas include the Federal Aviation Administration (FAA), the Volpe National Transportation Systems Center, and the JPDO. Relevant research underway includes work in wake hazards, surface surveillance, de-icing procedures, regional operations, and environmental modeling. Potential industry partners who responded to the ARMD and ASP Request for Information (RFI) indicate interest in conducting R&D in regional airport operations, airport functions of the Evaluator, closely spaced parallel approaches, virtual towers, and procedures for addressing environmental constraints. Potential partnerships in academia will further enable the NGATS ATM-Airportal Project to address airport technologies and procedures. Relevant work currently underway at universities includes environmental model enhancement, optimization algorithm development, and human/automation interaction relevant to decision-support tools. Teaming with these organizations will broaden the NGATS ATM-Airportal Project's portfolio of R&D for airport solutions.

#### **1.2.5 Alignment with JPDO Vision**

The NGATS ATM-Airportal Project supports the technology development areas identified by ARMD and ASP in the Internal Call for Proposals. Each technology development area represents a subset of one or more NGATS core capabilities (i.e., Super-Density Operations, Equivalent Visual Operations, and Aircraft Trajectory-Based Operations) that will characterize the 2025 NGATS Operational Concept as defined by the JPDO.

The following section will discuss the NGATS core capabilities with the greatest impact on airport operations and the identify NGATS ATM-Airportal Project research focus areas

relevant to the core capabilities. The capabilities are: Equivalent Visual Operations, Super-Density Operations, and Aircraft Trajectory-Based Operations.

### ***1.2.5.1 NGATS Core Capabilities***

The JPDO has defined a set of core capabilities that are missing from today's air transportation system that will, according to its vision, characterize the NGATS.<sup>5</sup> Of these capabilities, the NGATS ATM-Airportal Project will focus on those that will help increase landing and departure capacity at the nation's busiest airports. The capabilities are:

- Equivalent Visual Operations
- Super-Density Operations
- Aircraft Trajectory-Based Operations

#### **1.2.5.1.1 Super-Density Operations**

Super-Density Operations is an NGATS core capability that refers to airport operations in which the spacing between aircraft has been significantly reduced below what is required today. Twin goals seek to increase throughput of the runway complex and achieve the highest possible efficiency in the use of gates, taxiways, runways, and approach airspace.

#### **1.2.5.1.2 Equivalent Visual Operations**

Equivalent Visual Operations is an NGATS core capability that refers to the ability to achieve visual operations in non-visual conditions. The goal is to enable more runways at more airports to be used at, or near, full capacity at all times by eliminating poor, or no, visibility due to terrain and bad weather. New sensors and displays will allow pilots to fly as if they were operating in visual meteorological conditions (VMC) when in fact they are operating in instrument meteorological conditions (IMC). Pilots will know the location of other traffic and terrain, and the type of weather to be encountered in real time.

#### **1.2.5.1.3 Aircraft Trajectory-Based Operations**

Aircraft Trajectory-Based Operations is an NGATS core capability that will build on eight other NGATS core capabilities<sup>6</sup> to manage aircraft operations by planned trajectories and adjust the airspace structure dynamically. The goal is to provide a clearer, more dynamic understanding of the NAS in order to improve capacity by regularly adjusting the NAS structure to match user needs and meet special-use airspace requirements, ensure safe separation between aircraft, and meet safety and environmental standards.)

## ***1.3 NGATS ATM-Airportal Project Milestones and Metrics***

The NGATS-ATM Airportal Project's milestones and metrics for measuring progress toward specific deliverables is being developed. Details will be available soon.

### **1.3.1 NGATS ATM-Airportal Project R&D Roadmap**

A refined 10-year roadmap for conducting NGATS-ATM- Airportal Project research is being developed. The roadmap will show a long-range vision for research in support of the JPDO vision, the NGATS Operational Concept, and core capabilities in Super-Density Operations, Equivalent Visual Operations, and Aircraft-trajectory-Based Operations. The roadmap will take into account the most significant technical obstacles to achieving the vision, concept, and

capabilities and will identify the R&D needed to overcome them. It will also consider the annual anticipated cost of carrying out the R&D and the technical milestones that will be used to evaluate the R&D. Details will be available soon.

### ***1.4 Technical Approach***

The NGATS-ATM Airportal Project's technical approach to conducting airportal research and development for the airportal environment in support of key NGATS capabilities is being developed. Details will be available soon.

## Appendix A. ACRONYMS

\$K	Dollars in Thousands	HITL	Human-in-the-loop
3D	three-dimensional	ICAO	International Civil Aviation Organization
4D	four-dimensional	IIFD	Intelligent Integrated Flight Deck Project
AATT	Advanced Air Transportation Technologies Project	IMC	instrumented meteorological conditions
AC	aircraft	IPT	integrated product team
ACES	Advanced Concept Evaluation Simulation	JPDO	Joint Planning and Development Office
ADS-B	Automatic Dependent Surveillance-Broadcast	L1	Level 1
ANSP	air navigation service provider	L2	Level 2
AOC	Airline Operations Center	L3	Level 3
AP	Airportal	L4	Level 4
AP	Action Plan	LAX	Los Angeles International Airport
APREQ	APproval REQuest	MEM	Memphis International Airport
ARMD	Aeronautics Research Mission Directorate	MM5	Fifth-Generation Mesoscale Model
ARTCC	Air Route Traffic Control Center	MoA	Memorandum of Agreement
AS	Airspace	NAS	National Airspace System
ASDE-X	Airport Surface Detection Equipment	NCAR	National Center for Atmospheric Research
ASP	Airspace Systems Program	NEXTOR	National Center for Excellence in Aviation Research
ATCT	Air traffic control tower	NGATS	Next Generation Air Transportation System
ATM	air traffic management	NRA	NASA Research Announcement
ATSP	Air traffic service provider	NTSB	National Transportation Safety Board
AVOSS	Aircraft Vortex Spacing System	NTX	North Texas Research Station
AvSP	Aviation Safety Program	NWS	National Weather Service
CAASD	Center for Advanced Aviation System Development	OEP	Operations and Engineering Panel
CAP	Collaborative Arrival Planner	OGA	Other Government Agency
CDTI	Cockpit display of traffic information	OOOI	Out, Off, On, In
CET	Con Ops Evaluation Team	ORD	Chicago O'Hare International Airport
CFD	computational fluid dynamics	PI	principal investigator
CNSI	Communications Navigation and Surveillance Information	PM	project manager
Co-PI	co-principal investigator	PMC	Program Management Council
CPTP	Conflict Prediction and Trial Planning	PSU	Pennsylvania State University
CS	civil servant	R&D	research and development
CSPR	closely spaced parallel runway	RFI	Request for Information
CTAS	Center-TRACON Automation System	RTCA	Formerly the Radio Technical Commission for Aeronautics
D2	Direct-To	RTSP	Required Total System Performance
DGPS	Differential Global Positioning System	RUC	rapid update cycle
DoC	Department of Commerce	SAA	Space Act Agreement
DoD	Department of Defense	SATNAV	Satellite Navigation
DHS	Department of Homeland Security	SATS	Small Aircraft Transportation System Project
DPM	deputy project manager	SAU	Strategic Airspace Usage Project
EADS	Evaluation and Analysis Division	SDO	Super-Density Operations
EDP	Expedite Departure Path	SMS	Surface Management System
ETMS	Enhanced Traffic Management System	SPRT	Super Problem Resolution Team
FAA	Federal Aviation Administration	SWIM	System-wide Information Management
FAST	Final Approach Spacing Tool	TAAM	Total Airspace and Airport Modeler
FedEx	Federal Express	TAP	Terminal Area Productivity Project
FFC	FutureFlight Central	TASS	Terminal Area Simulation System
FTE	full-time equivalent	TCAS	Traffic Alert and Collision Avoidance System
FY	fiscal year		

TDAWP	TASS Derived Algorithms for Wake Vortex	V&V	Verification and Validation
TIM	technical interchange meeting	VMC	Visual Meteorological Conditions
TMA	Traffic Management Advisor	WakeVAS	Wake Vortex Advisory System
TRACON	Terminal Radar Approach Control	WBS	work breakdown structure
UPS	United Parcel Service	Wx	weather
VAMS	Virtual Airspace Modeling and Simulation Project	WYE	work year equivalent

## Appendix B. REFERENCES

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<sup>1</sup> Sullivan, B. Hallowell, S., , D., Rhodes, D., Baker, D., Burleson, C., Andrews, A, Howell, J., “NGATS 2025 Operational Concept,” v4.8c,Oct.2005.

<sup>2</sup> Next Generation Air Transportation System Integrated Plan, December 2004.

<sup>3</sup> Ibid

<sup>4</sup> Sullivan, B. Hallowell, S., , D., Rhodes, D., Baker, D., Burleson, C., Andrews, A, Howell, J., “NGATS 2025 Operational Concept,” v4.8c,Oct.2005.

<sup>5</sup> Ibid

<sup>6</sup> Ibid